A RESEARCH AND DEVELOPMENT POLICY FOR BRITISH COLUMBIA IN THE EIGHTIES

SCIENCE COUNCIL OF BRITISH COLUMBIA

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A RESEARCH & DEVELOPMENT POLICY FOR BRITISH COLUMBIA IN THE EIGHTIES

THE PRESENT SITUATION

The economy of British Columbia is heavily dependent on such natural resource industries as Forestry, Mining, Agriculture and Fishing. The primary and related processing sectors contribute 40% of the province's Gross Domestic Product. The services sector relies almost exclusively on the resource industries for its business.

It is clear from the present economic situation that the province's resource industries are vulnerable to many outside factors, and that these factors produce a history of both growth and recession. Many are beyond local control, responding to world demand and market prices. Others, however, originate in British Columbia: industrial efficiency, raw material costs, labour availability and cost, and government regulation.

A key factor in efforts to increase industrial growth and efficiency in the province is the degree to which TECHNOLOGY can be applied. Such application can only occur with a healthy program of scientific and engineering research and development.

The present level of research and development activity in British Columbia is embarrassingly low! At the same time as the government of Canada has implemented a policy of raising the national level of research and development from 1.0% of Gross National Product in 1979 to 1.5% in 1985, the comparable figure for British Columbia is 0.6%. That percentage puts this province in the same league as Iceland (0.7%) and Ireland (0.8%) but well behind Finland (1.1%), Norway (1.4%) and Australia (1.0%).

A CHANGE OF DIRECTION

The Science Council of British Columbia urges the Government to take immediate steps to improve the situation. The Government is looking for ways to make the provincial economy less susceptible to the ebb and flow of international demand for our raw materials and industrial commodities. SCIENCE AND TECHNOLOGY can stimulate the economy by improving the competitive position and profitability of existing industries and by encouraging the expansion of industry into new areas.

It can only do this, however, if support and encouragement are given to industries, research institutes and Government departments. Furthermore, these agencies must cooperate in the development and application of new technology. The potential benefits of increased scientific and research activity are three-fold:

1) It will tend to attract and give rise to new, high-technology businesses which rely on expertise and knowledge, rather than cheap raw materials or labour. Such industries tend to be affected less by the cyclical nature of the primary resource industries, they can provide unusually high rates of growth, and they are less affected by geographical limitations than traditional heavy manufacturing. Also, they can be environmentally compatible with urban locations and can provide employment for many highly trained British Columbians who must now leave the province to find suitable work.

2) It will lead to the development of new products and processes that use the province's raw materials. This has the benefit of creating greater employment and economic activity in the secondary manufacturing and service industries.

3) It will lead to an improved technical and scientific awareness which can, in turn, contribute to increased efficiency and productivity in the primary resource industries on which we will continue to depend.

High technology success stories are not restricted to Japan, the United States and certain Western European countries. Here, in British Columbia, there are glowing examples of the potential of high technology. For example, MacDonald-Dettwiler and Associates, an electronics firm based in Richmond, is a world leader in its field. The company started as a small two-man operation in 1969 and, just twelve years later, in 1981, employed over two hundred people and had annual sales (80% for export) in excess of $14 million. Cominco Ltd., at its Trail Electronic Materials Division, with its gallium arsenide substrate for microwave integrated circuitry; and CTF Systems Inc. of Port Coquitlam with its SQUID magnetometers and associated computerized scanning systems, are two further examples.

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(Note: Studies by the General Electric Company into the factors affecting economic growth in the United States have produced some interesting results:

a) High technology industries grow almost three times as fast as low technology ones.

b) Productivity, measured as output per employee in a high technology industry was twice that experienced in low technology.

c) In the United States, employment in high technology industries has been growing almost nine times faster than in low technology ones. This is due in part to the fact that the high technology industries are usually new and small, and therefore grow faster than mature companies.)

RECOMMENDATIONS

1. INCREASE SUPPORT FOR RESEARCH AND INNOVATION

a) Increase Science Council of B.C. grants in support of Research and Development projects of economic importance to the province to an annual level of $7 million (1982 dollars). (1981-82 funding $5.5 million, 1982-83 funding $3.8 million.) Recommendation: $7 million per year.

b) Increase support for health care and medical research through the B.C. Health Care Research Foundation. (Present funding level is $2.7 million per year, from the Lotteries Fund.) Recommendation: $5 million per year.

c) Increase support for the Core Research Program of B.C. Research in areas of provincial importance. Recommendation: $5 million per year.

d) Low Interest Loans - Another alternative for encouraging the development and implementation of new technology in the province is a program of government-sponsored low interest loans, similar to the program supported by the Federal Business Development Bank. It must be appreciated that in most instances R and D expenses account for only a small fraction of the costs associated with the exploitation of an innovation. Low interest loans would help bridge the financial gap between research and commercial production. Recommendation: guarantee the bank prime rate to those worthy applicants.

2. IMPROVE ENVIRONMENT FOR BUSINESS ACTIVITY AND INVESTMENT

In financial terms, innovation is a risky business. On average only about 10% of R and D projects are economically successful and finding venture capital is a common problem for innovators. The current recession and simultaneous curtailment of much R and D activity has made it clear that incentives are required to generate sources of venture capital. The Government of British Columbia should encourage potential investors to consider research and scientific innovation as a good investment opportunity. Some measures which could be implemented could be based on the following federal programs:

a) Encourage research activities through appropriate tax measures. Consider extension of existing Federal tax measures to provincial taxes, permitting a similar deduction.

b) Institute a "Negative Income Tax"

In normal times, credits against income tax represent a powerful and effective motivation for research and development expenditures. However, the current net loss position of many Canadian companies has reduced the number who are able to take advantage of tax write-offs. In some cases, the tax incentives from R and D may not be applicable for several years to come.

An alternative which may be appropriate in times of low profitability and for newly-formed companies would be the introduction of a "negative income tax". Through this, Canadian companies performing research and development would have the option of claiming a cash advance from the government equal to the savings the taxpayer would have been able to claim in a year of normal profitable operation.

c) Encourage Research and Development activities by the promotion of "limited partnership" arrangements.

In an attempt to improve the risk/return ratio of investment in R & D, the federal government has instituted a program of federal tax incentives to encourage the formation of limited partnerships. Entrepreneurs can use these partnerships to raise capital for research and development work. Investors are then eligible for a wide range of tax deductions (currently under review by the Federal Government).

d) Provincial Sales Tax

Sales taxes on equipment, materials and instrumentation destined for research and development activities should be removed. While this action would in the short-term reduce provincial revenues, in the long-term, benefits accruing to the province from increased industrial activity should more than compensate. ($3 million per year is the estimated early loss of revenue.)

e) Government Regulations Affecting R & D

The decision to conduct R & D or to innovate rests ultimately with industry itself. Consequently, the government's role in the innovation process should be limited to creating suitable conditions and providing appropriate assistance.

In order to foster an investment climate which is favourable to R & D innovation, the federal and provincial governments should examine their respective regulatory systems to ensure that they do not inhibit business. Restrictive legislation governing mergers, investment, competition and market share should be reviewed to determine their effectiveness, and modified where appropriate. For example, clear guidelines from the F.I.R.A. for R & D type takeovers would be useful.

3. PROMOTE RESEARCH OF IMPORTANCE TO THE PROVINCE

Government programs in support of research and scientific activities should: (i) promote areas with an economic or social benefit to the province, and (ii) promote areas where there is an existing base of expertise and "know-how".

It is important to build on areas of existing local expertise and emphasize research which can provide a high added value to our natural resources. The following sectors have been identified as meriting increased research activity (in alphabetical order):

a) Agriculture and Food - Plant genetics, hydroponics, greenhouse technology, and biological control systems are a few of the R & D areas which could help reduce our dependence on imported foodstuffs.

b) Aquatic Sciences and Mariculture - To take advantage of the 200 mile limit and fully exploit the production potential of the province's water resources much R & D is required. Ocean engineering is an important related field.

c) Biotechnology and Bioengineering - There is considerable local expertise in this rapidly expanding field and the potential applications are extremely varied - from pharmaceuticals, biomass energy to microbiological leaching of mineral ores.

d) Computer software and technology - Process control, and CAD/CAM are two aspects which warrant research support.

e) Electronics and Communications - Telecommunications, earth surveillance and electronic remote sensing for forestry, agriculture, mineral exploration etc., are important areas of local expertise. The province's high technology industries should receive encouragement to further their competitiveness, especially in export markets.

f) Energy - Energy research is, at present, heavily funded in most developed countries in an attempt to find substitutes for non-renewable and increasingly expensive oil and natural gas supplies. British Columbia has no unique energy problems requiring specialized forms of research, but should encourage the efficient utilization of its natural gas and hydroelectric resources, exploration for geothermal sites, and maintain a high level of knowledge regarding combustion, coking, gasification and liquefaction of coal. Also British Columbia could become a centre of expertise in the use of biomass as a renewable energy resource.

g) Environment - Environmental research has important social impacts and may have implications for economic development. A reasonable balance between these two objectives is required. Environmental and industrial health legislation pending in Canada, U.S.A., and Europe shows that the development of standards and controls to ensure safe working conditions and safe transportation and disposal of chemicals and waste products will be the responsibility of government.

h) Forestry and Forest Products - A review of spending in this sector indicates that R & D activities are extremely low relative to its importance in the economy of the province, particularly in silviculture and other areas of forest preservation and improvement.

i) Health Care - British Columbia has a strong and varied medical research community. For example, the facilities at the UBC Acute Care Hospital, other affiliated teaching hospitals, and TRIUMF, permit advanced research into advanced diagnostic techniques, including nuclear medicine.

j) Manufacturing - Much research is needed to improve the effectiveness of our existing manufacturing industry by means of improved productivity, to increase the value-added component of our forest products and mineral processing industries, and to attract so-called "foot-loose" industries.

k) Mining and Mineral Processing - British Columbia already has considerable expertise in mining, mineral processing and metals. Research in such areas of biotechnology, electrolysis and electrowinning would open up further opportunities in mineral technology.

l) Transportation - Research is urgently needed to solve transportation problems related to economic development and our urban social structure.

4. TRAIN SCIENTIFIC AND TECHNICAL MANPOWER

a) The government should increase support for programs aimed at the training of highly qualified manpower for employment in local industry. The Science Council's Graduate Research in Engineering and Technology (G.R.E.A.T.) awards and Industrial Postdoctoral Fellowships (IPDF) both assist in the support and training of research manpower for technology-based industry.

b) The province should ensure that there is an adequate supply of trained scientists and technologists and other skilled manpower required for future expansion of both primary and secondary industry. This requires support for the training of future engineers, scientists, technologists and technicians in the province's universities, colleges, institutes and pre-apprenticeship programs.

c) Programs to encourage the employment of newly-qualified scientists and technicians in local industry should be expanded. The Science Council's IPDF program is providing this support for researchers with Ph.D's, but the scope could be expanded to include other levels of scientists and technologists. This would encourage local industries to increase their scientific and technological capabilities and provide employment for young people in our post-secondary education system.

5. ASSIST INNOVATORS AND NEW BUSINESS VENTURES

The Science Council of British Columbia recognizes the difficulties associated with taking an innovation from the laboratory to the marketplace, and has appointed an Innovation Coordinator, in cooperation with the Discovery Foundation, to assist entrepreneurs with this process. The Innovation Office will attempt:

a) To encourage inventors and researchers to have their 'inventions' assessed for technical and econonomic feasibility, patentability and the desirability of further development;

b) To assist in the provision of technical expertise essential for the successful product/process/system development from the stage provided by the inventor to a marketable stage;

c) To bring together the inventors and the interested entrepreneurs and to provide support and encouragement for the formation of manufacturing and marketing units, e.g., patent advice, incorporation advice, market studies, financing advice, etc.;

d) To provide the additional management assistance prerequisite to the formation and guidance of those small business organizations which play such a large role in industrial innovation;

e) To seek or provide 'seed' money to invest in new ventures.

Some additional government financing will be required.

6. USE GOVERNMENT POLICY TO SUPPORT BRITISH COLUMBIA INDUSTRY AND RESEARCH

a) Strengthen provincial government policy of seeking local suppliers of scientific goods and services. The scientific, technological and research needs of ministries, Crown corporations, regulated utilities and agencies should be contracted out to British Columbia industries, research institutes and universities, whenever possible to stimulate the development of local expertise.

Since 1973 the Science Centre of the Department of Supply and Services has been the central agency for the administration of scientific and research contracts under the federal contracting-out policy. During the year ending March 31, 1982 the Science Centre issued over 3,000 contracts valued in excess of $200 million. Of this total, over 550 contracts worth almost $30 million were awarded to British Columbia companies and researchers. Thus British Columbian scientists and engineers received 15% of the Federal funds available by this route. The provincial government should encourage and support British Columbia's scientific community in actively competing for Federal contracts and to make submissions to the parallel Unsolicited Proposal Program.

b) International Sources

The Defence Off-set Program of the Canadian and United States governments is an example of funding that is available for the provision of goods and services to foreign governments. Under this program $3.5 billion is available to off-set Canadian military purchases in the United States over the next ten years.

Efforts by the Ministry of Industry and Small Business Development to promote B.C. participation in this and other national and international programs should be continued.

7. SUPPORT THE LOCATION OF MAJOR SCIENTIFIC FACILITIES IN BRITISH COLUMBIA

a) Research projects of national importance increase the technological resources of the local region in both skilled manpower and industrial capability. An example of this is the TRIUMF cyclotron. Among the present technical spin-offs produced by TRIUMF are:

Pion Cancer Therapy	Electronic Circuits & Control Technology
Radioactive Isotope Production	N/C Machining
Positron Emission Tomography	High Vacuum Technology
	High Speed Data Handling

Other examples are the research facilities of Microtel Pacific Research, B.C. Hydro, Cominco, B.C. Research and the Institute of Ocean Sciences.

b) Location of the key installation of the National Research Council's Long Baseline Array radiotelescope system would provide similar spin-off benefits and opportunities for British Columbia's scientists and engineers.

c) A computer-aided design and manufacturing (CAD/CAM) centre and a biotechnology research centre are other projects of national importance which might be located in British Columbia.

Based on favourable cost-benefit analyses, the provincial government should be prepared to encourage the location in this province of such facilities, since these centres tend to draw funds from outside the province.

8. COORDINATE GOVERNMENT/UNIVERSITY/INDUSTRY RESEARCH ACTIVITIES

a) Programs (e.g., Science Council grants, scholarships and fellowships) which promote the collaboration of the Province's university researchers with industry and government should receive increased support. In this way existing research expertise and facilities can be directed to problems of provincial importance.

b) The Science Council and Research Secretariat of British Columbia should act as the central bodies for the coordination of policy and information on the scientific and research activities being performed in British Columbia.

c) The Internal Research Advisory Committee (IRAC) should develop its role as a policy and review body for the Provincial Government's internal research activities, and maintain close liaison with the Science Council and Research Secretariat.

9. ENCOURAGE PUBLIC AWARENESS OF THE BENEFITS OF SCIENCE AND RESEARCH

The province should support initiatives aimed at improving public awareness of scientific and technological activities in British Columbia. This can take many forms from the establishment of science centres (e.g., the Planetarium, the Arts, Science & Technology Centre, the Aquarium and others throughout the province), support of public events (e.g. "Discovery Fair"), Science Council's Science and Engineering Gold Medals, to improved science education in the school system. Such programs should be aimed at the entire population, but special emphasis should be placed on reaching the young student who may not be aware of the opportunities available in British Columbia in science and technology.

10. PROVIDE SUITABLE LOCATIONS FOR TECHNOLOGY-BASED INDUSTRY

The province should undertake a vigorous promotional campaign to encourage entrepreneurs and "footloose industry" to establish in British Columbia. High technology industries, for example, can develop without a resource base in the region and, often, can compete more easily than primary industries in export markets. They depend more on innovative thinking, an adequate supply of venture funding and a pool of technological expertise. The products of high-technology industry are often ideas or devices which do not depend strongly on the proximity to markets but thrive, rather, where living conditions are congenial. British Columbia is potentially a very favourable location for such industries.

In 1979 the Provincial Government provided initial funds to create Discovery Parks, a series of industrial research parks located near the three provincial universities and the British Columbia Institute of Technology. Discovery Parks' aim is to attract and assist the development of capital-intensive, high-technology industry and foster close links between industry and the neighbouring educational centres. The R & D parks should provide sites for scientists and technologists, and thus provide the 'magnet' and spin-off benefits of a concentration of innovative, knowledge-based industries.

11. SUPPORT CULTURAL AND SOCIAL AMENITIES

It is recognized that the attractiveness of an employment opportunity is not now solely related to remuneration and perquisites. The nature of a community's cultural, sporting, recreational, and social amenities now bear strongly on a decision to locate (or not to locate) in a region. The potential of B.C. Place is a current example of the B.C. Government's recognition of this fact. Much more can be done, particularly in the support of such activities in centres throughout the province.

APPENDIX 1

GROSS EXPENDITURE ON R AND D AS A PERCENTAGE OF PROVINCIAL GROSS DOMESTIC PRODUCT

	1979		1980	
CANADA	$\frac{2,669}{269,321.4}$	= .99%	$\frac{3,097}{297,449.5}$	= 1.04%
B.C.	$\frac{165}{32,698.6}$	= .50%	$\frac{203}{36,507.3}$	= .55%
ALBERTA	$\frac{262}{34,542.5}$	= .76%	$\frac{322}{40,173.6}$	= .80%
WESTERN PROVINCES	$\frac{578}{88,606.6}$	= .65%	$\frac{712}{100,827.5}$	= .71%
QUEBEC	$\frac{586}{61,760.6}$	= .94%	$\frac{639}{67,792.4}$	= .94%
ONTARIO	$\frac{1,313}{102,037.9}$	= 1.28%	$\frac{1,569}{111,739.6}$	= 1.40%
ATLANTIC PROVINCES	$\frac{180}{16,057}$	= 1.12%	$\frac{161}{16,167.2}$	= .99%

NOTE: $100X \frac{\text{Gross Expenditure on Research and Development (\$ Million)}}{\text{Provincial Gross Domestic Product (\$ Million)}} = \%$

SOURCE: Science Statistics Centre, Statistics Canada

APPENDIX 2

Gross Expenditures on Research and Development (GERD)
as a Percentage by Performing and Funding Sector

	CANADA 1979		BRITISH COLUMBIA 1979	
	Funding Sector	Performing Sector	Funding Sector	Performing Sector
Federal	38.9	25.5	40.0	23.0
	} 45.8		} 46.1	
Provincial	6.9	3.6[1]	6.1	5.5[1]
Industry	35.8	44.2	27.3	32.7
University	13.9[2]	25.9	21.2[2]	37.6
Other	4.4	0.8	5.4	.6

NOTES:

1. This includes Provincial Research Organizations

2. Reported University funding for research is derived from general salary and administrative support, mostly from Provincial and Federal Sources.

SOURCE:

Background Notes on R & D Policies, Planning and Programming for the Honourable John Roberts, Minister of State for Science and Technology and Minister of the Environment at a meeting at the Toronto Board of Trade, January 19, 1981.

CURRENT INTRAMURAL SPENDING ON RESEARCH AND DEVELOPMENT BY INDUSTRY: 1979(3)

	Intramural Spending[1] Millions of Dollars		Persons Engaged in R&D[2] Person-Years	
	B.C.	Canada	B.C.	Canada
Mines & Oil and gas wells	5	66	115	990
Chemical Based	1	206	50	4,925
Wood Based	14	46	315	1,190
Metals	3	80	51	1,875
Machinery & Transportation Equipment	5	261	90	5,700
Electrical	7	238	245	6,405
Other Manufacturing	-	11	4	335
Services	8	139	230	3,200
TOTAL	43	1,047	1,100	24,620

[1]Statistics Canada. Science Statistics Centre. Standard Industrial R&D Tables: 1972 - 1981. Pg. 42 Table 20 "Current Intramural R&D Expenditures by Industry Group and by Region 1979."

[2]IBID. Pg. 49, Table 31. "Number of Persons Engaged in R&D by Industry Group and by Region, 1979."

[3]Exclusive of capital expenditures.

GROSS EXPENDITURE ON R & D AS A PERCENTAGE OF GNP FOR OECD COUNTRIES[1]
(N.B. 1979 unless otherwise indicated)

(1)	2.5%	U.S.A.
(2)	2.4%	Germany
(3)	2.4%	Switzerland
(4)	2.2%	U.K.
(5)	2.0%	Japan
(6)	2.0%	Netherlands
(7)	1.9%	Sweden
(8)	1.8%	France
(9)	1.4%	Norway
(10)	1.4%	Belgium
(11)	1.1%	Finland
(12)	1.0%	Canada (1.07%, 1981)[2]
(13)	1.0%	Australia
(14)	1.0%	Denmark
(15)	0.8%	Ireland
(16)	0.8%	Italy
(17)	0.7%	Iceland
(18)	0.3%	Portugal (1978)
(19)	0.2%	Greece

(1) OECD Observer, No. 115 March 1982, Page 26-7

(2) Ministry of State for Science and Technology. Federal Scientific Activities: 1982/1983, Ottawa: Supply and Services Canada, 1982. Page iv.

APPENDIX 5

INTERNATIONAL COMPARISONS OF R & D IN THE NATURAL SCIENCES: 1979 (unless otherwise stated)

Expenditures/GDP

Country	TOTAL[1]	FUNDING SECTOR[2]			
		Government	University	Industry	Others
B.C.	0.5%	0.24%	0.09%	0.14%	0.03%
Canada	1.0%	0.46%	0.14%	0.36%	0.04%
	1.5% (1985 target)	0.59%	0.11%	0.75%	0.04%
Australia	1.0% (1978/79)	0.56%	0.14%	0.26%	0.03%
Denmark	1.0%	0.27%	0.20%	0.51%	0.01%
Finland	1.1%	0.31%	0.16%	0.60%	0.02%
France	1.8%	0.67%	0.10%	0.74%	0.27%
Germany	2.4%	0.99%		1.33%	0.07%
Japan	2.0% (1979/80)	0.32%	0.22%	1.32%	0.14%
Norway	1.4%	0.45%	0.35%	0.57%	0.03%
Sweden	1.9%	0.49%	0.24%	1.13%	0.04%
USA	2.5%	1.28%	0.08%	1.09%	0.05%

1 OECD Observer, No. 115, March 1982. Pg. (26-27)

2 Background Notes on R & D Policies, Planning and Programming for the Honourable John Roberts, Minister of State for Science and Technology and Minister of the Environment at a meeting of the Toronto Board of Trade, January 19, 1981. R & D Policies, Planning and Programming, January 1981, pg. 2.

APPENDIX 6

INDICATORS OF PROVINCIAL SCIENTIFIC ACTIVITIES: UNIVERSITIES

Province	Graduate student index, 1979-80(1)		Sponsored research in universities per capita, 1979-80(2)	
	(No.)	Rank	($)	Rank
Newfoundland	0.9	8	15.05	5
Prince Edward Island	-	10	-	10
Nova Scotia	2.0	3	13.75	7
New Brunswick	0.9	8	10.67	9
Québec	2.2	2	16.04	4
Ontario	2.3	1	18.89	2
Manitoba	2.0	3	22.69	1
Saskatchewan	1.1	7	17.01	3
Alberta	2.0	3	14.42	6
British Columbia	1.9	6	12.99	8
Canada	2.0		16.51	

(1) Granduate student index = number of full-time graduate students per 1,000 provincial population over the age of fifteen years.

(2) Sponsored research in universities per capita = total research money granted to universities ÷ provincial population.

SOURCES:

Full-time enrolment for graduate degrees, per capita (15 and over) Universities Enrolment and Degrees, 1979-80, Statistics Canada Catalogue No. 81-204 and Estimates of Population by Sex and Age for Canada and the Provinces, June 1979, Statistics Canada Catalogue No. 91-202.

Financial Statistics of Universities and Colleges, 1979-80, Statistics Canada

APPENDIX 7

INDICATORS OF PROVINCIAL SCIENTIFIC ACTIVITIES: INDUSTRY

Province	Value added by manufacturing industry per capita, 1978(1)		Current intramural industrial R & D expenditures per employee in primary and secondary industry, 1979(2)	
	($)	Rank	($)	Rank
Newfoundland	662.1	8	16.00	9
Prince Edward Island	467.7	10	-	10
Nova Scotia	1,047.2	6	51.00	6
New Brunswick	1,040.9	7	29.00	8
Québec	2,212.7	2	330.00	2
Ontario	3,012.7	1	390.00	1
Manitoba	1,233.6	4	72.00	5
Saskatchewan	562.1	9	43.00	7
Alberta	1,141.2	5	279.00	3
British Columbia	2,022.2	3	117.00	4
Canada(3)	2,145.4		292.00	

SOURCE:

(1) Manufacturing Industries of Canada; National and Provincial Areas, 1978, Statistics Canada Catalogue No. 31-203.

(2) Results of 1979 Industrial R & D survey, Science Statistics Centre, Statistics Canada and The Labour Force, July, 1981, Statistics Canada Catalogue No. 71-001.

(3) Includes the Yukon and Northwest Territories.

APPENDIX 8

INDICATORS OF PROVINCIAL SCIENTIFIC ACTIVITIES: FEDERAL GOVERNMENT

Province	Expenditures on intramural natural science activities 1979-80(1)	Intramural manpower 1979-80(1)	Contracts awarded by the Science Procurement Sector, Department of Supply and Services, 1980-81(2)	
	($'000)	(Full-time equivalent)	(No.)	($'000)
Atlantic Provinces	108,394	2,273	408	10,845
Québec	54,253(3)	1,522(3)	316	39,216
Ontario	144,713(4)	4,094(4)	1,066	108,927
Ottawa - Hull	386,850	9,780	...	...
Manitoba	53,260	1,497	38	3,920
Saskatchewan	23,415	688	70	4,263
Alberta	44,395	1,286	94	4,808
British Columbia	69,730	1,604	482	21,009
Canada (5)	886,252	22,775	2,557	194,967

SOURCE:

(1) "Listing of Federal Natural Science Establishments, 1979-80", Science Statistics Centre, Statistics Canada.
(2) Research and Development Bulletin, April 1981, Supply and Services.
(3) Excluding Hull.
(4) Excluding Ottawa.
(5) Includes the Yukon and Northwest Territories.

APPENDIX 9

INDICATORS OF PROVINCIAL SCIENTIFIC ACTIVITIES: PROVINCIAL RESEARCH ORGANIZATIONS

Province	Current expenditures on R & D 1980 (1)	
	($'000)	Rank
Nova Scotia	1,447	6
New Brunswick	1,150	7
Québec	8,212	3
Ontario	8,600	2
Manitoba	889	8
Saskatchewan	3,472	4
Alberta	12,079	1
British Columbia	2,542	5
Total	38,391	

SOURCE:

(1) Science Statistics Vol. 5, No. 11, Statistics Canada Catalogue No. 13-003.